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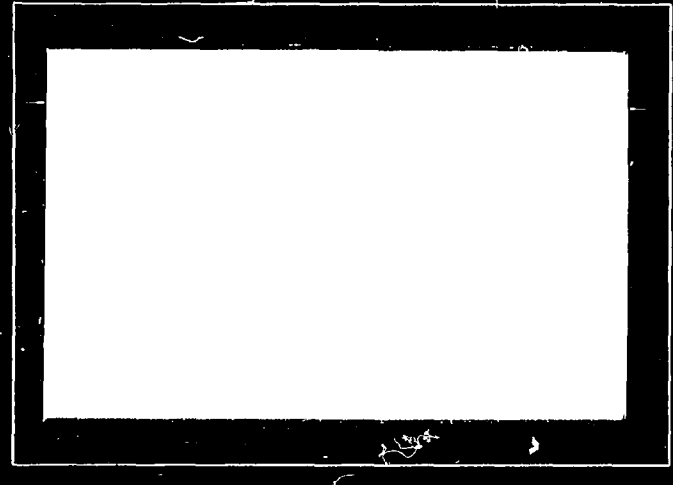

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CHEMISTRY DIVISION - PROTECTIVE CHEMISTRY SECTION

16 January, 1946

CHAMBER TESTS WITH HUMAN SUBJECTS

XV. TESTS OF WORN CARBON CLOTHING

By

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Report No. P-2702

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Preliminary Pages - - - - - a - c
Numbered Pages - - - - - - 14
Appendices - - - - - - - - 1
Tables - - - - - - - - - - 32
Distribution List - - - d

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ABSTRACT

In this report are described the results of chamber tests of carbon clothing worn during two wearing trials at Camp Lejeune, N. C.

It was found that approximately 2 weeks was the limit of the useful wearing life of carbon-rayon cloth of the #176 type. It was indicated that the spun rayon type had better wearing qualities than the other carbon-rayon types.

It was found that H-contaminated worn carbon clothing presents a potential hazard to the wearer as a result of desorption.

The ratio of protection afforded by new and worn carbon-rayon #110 suits against HN-1 was similar to that against H.

Table of Contents

INTRODUCTION

A. Authorization

1. This work was authorized under Project 547/41, "Maintenance, Bureau of Ships", dated 16 December 1940. The problems which were proposed for study were given in Bureau of Ships letter S-S77-2 (Dz), Serial 811, of 17 December 1940.

B. Statement of Problem.

2. This investigation was undertaken to evaluate the protection against vesicant vapors afforded by worn clothing containing activated carbon.

C. Known Facts Bearing on the Problem and Theoretical Considerations

3. It has been established by wearing trials conducted by this Laboratory and others that the protective capacity of chemically impregnated clothing decreases rapidly with even short periods of wear under semi-tropical conditions. This can be attributed largely to the rapid loss of active chlorine during the wearing period. Little information is available on the wearing qualities of carbon clothing. However, the mechanism by which carbon clothing gives protection is radically different from that by which chemically treated clothing gives protection. Therefore, the factors which cause the rapid loss of protective capacity of chemically impregnated clothing do not necessarily apply to carbon clothing. There are two main factors which may affect the protective capacity of carbon clothing during wear. These are poisoning of the carbon and loss of carbon from the garment. Substances which might poison the carbon during wear include sweat, solvents, oil, grease, fumes, fuels, and others. It has been demonstrated physiologically, that oil and S-330 Protective Ointment increase the desorption of vesicants from contaminated carbon clothing (See NRL Report No. P-2604). Laboratory data have indicated that other substances might also cause the same effect. The loss of carbon from the garment will depend in great measure on the method by which the carbon is incorporated in the cloth. The coated and impregnated types will lose carbon by "crocking", due to abrasion and flexing of the cloth. The carbon-rayon types lose carbon due to the brittle nature of the fiber containing the carbon. On abrasion and flexing, these fibers break into small fragments which gradually break loose and fall away from the cloth.

4. The data presented in this report were taken from chamber tests of carbon clothing worn in two wearing trials conducted by this Laboratory. These trials were carried out during the summers of 1944 and 1945 at Camp Lejeune, N. C. The 1944 trials were concerned primarily with CC-2 impregnated

clothing. A complete description of the 1944 trials is given in NRL Report No. P-2406. The 1945 trials were concerned primarily with carbon clothing and are described in NRL Report No. P-2682.

D. Previous Work Done at This Laboratory.

5. This report is the fifteenth of a series on "Chamber Tests with Human Subjects" in which the results obtained in the evaluation of various protective equipment against the vesicant effects of persistent chemical warfare agents are reported. The fourth, fifth, thirteenth and fourteenth reports of this series, NRL Reports Nos. P-2239, P-2464, P-2604 and P-2701 describe earlier work on carbon clothing. NRL Reports Nos. P-2322, P-2510, P-2570 and P-2655 describe additional studies on carbon clothing including physiological data. NRL Reports Nos. P-2406, P-2682 and P-2695 describe wearing trials of carbon clothing conducted by this Laboratory.

EXPERIMENTAL

A. Procedure.

6. The procedure employed for the chamber tests with worn carbon clothing was the same as that for the tests with new carbon clothing and is described in detail in NRL Report No. P-2701. The tests were conducted as 1-1/2 layer tests at CTs ranging from 300-1200 (60 min.) for H_2 and CT 2000 (60 min.) for HN-1, and at 90°F, 65% R.H. and 2 - 2.5 mph wind velocity. The men were given successive daily exposures until all had "broken" or were withdrawn by the Medical Officer for other reasons. The carbon clothing was worn continuously between exposures except in one test which will be described later.

B. Results and Discussion of Results.

(1) Suits from 1944 wearing trials.

(a) H Chamber Tests.

7. Three chamber tests were carried out on worn suits made from carbon-rayon cloths #110* and 148. Data from chamber tests with new suits made from these cloths are included for comparative purposes (data from NRL Report No. P-2701). The data obtained in the tests of the worn suits are summarized in Table I. More complete data are presented in Tables X through XII in the Appendix.

* The carbon-rayon suits labeled #110 in this report actually consisted of suits made from carbon-rayon cloths #110 and #127. The difference between these cloths is mainly one of weave and therefore no distinction is made between them.

Table I

H Chamber Tests - 1944 Wearing Trials.

Conditions: CT 1200 (60 min.); 90°F, 65% R.H.

Cloth Modification	Wearing Period	No. of Men	No. of Breaks	Av.No.Exp. Tolerated	Av.Total CT Tolerated
110	None	6	6	5.3	6360
110	1 land.+ 9 days	4	4	1.8	2160
110	3 land.+ 5 days	4	4	1.3	1560
148	None	4	2	10.5+	12600+
148	5 days jungle warfare	5	5	8.2	9840

8. The results in Table I show that the carbon-rayon #110 suits lost a large part of their protective capacity as a result of the landings and wear. In view of the good protection given by the worn carbon-rayon #148 suits, it is indicated that the landing operation represented a particularly severe type of wear in its effect on the protection given by the carbon-rayon #110 suits. Standard CC-2 impregnated suits worn during 3 landings + 5 days in the same trial tolerated 1.0+ (7/8 men "broken") exposures (CT = 1200+), those worn during 1 landing + 5 days tolerated 1.3+ (6/7 men "broken") exposures (CT = 1560+) and those worn during 5 days of simulated jungle warfare tolerated 2.1 exposures (CT = 2520). Thus, the CC-2 impregnated suits gave less protection after wear than the corresponding carbon-rayon #110 and 148 suits.

(b) H Desorption Test

9. The exposed carbon-rayon #148 suits were put on by new men immediately after they had "broken" in the chamber and were worn for an additional 3 days. No further exposures were given. It can be seen in Table XIII in the Appendix that a moderate to intense erythema was sustained by these men. It is obvious, therefore, that a significant degree of desorption occurred. One man who started in the chamber test was withdrawn after 7 exposures because of the burns sustained on the area subjacent to where he accidentally spilled fuel oil on his suit. A test for desorption

was also carried out on this suit and the new man also sustained burns on the same area (See Tables XII and XIII in the Appendix). This incident emphasizes the deleterious effect of oil on contaminated carbon clothing. This effect was discussed in NRL Report No. P-2604.

(c) H Leakage and Desorption Test.

10. New carbon-rayon #110 clothing does not show any leakage of H vapor as measured chemically under conditions comparable to those used for chamber exposures (unpublished data). However, worn carbon clothing does show leakage so that burns resulting from exposure to H vapor for worn clothing may be due to both desorption and leakage. In an effort to determine the effect of each factor, the following test was carried out.

11. Six carbon-rayong #110 suits worn 9 days at Camp Lejeune were issued to 6 men (Group 1) who wore them for exposures in the chamber only. Upon leaving the chamber, 6 new men (Group 2) put on the suits and wore them only until time for the next exposure. Whenever a man from Group 1 "broke", another man from a new group (Group 3) took his place for the exposures. When a man in Group 2 "broke", the suit was withdrawn from the test. The men in Groups 1 and 3 wore protective shorts, those in Group 2 did not. The exposures were to H vapor at CT 1200 (60 min.) A summary of the data obtained in this test is presented in Table II. More complete data are presented in Tables XIV through XVI in the Appendix.

Table II

H Leakage and Desorption Test

Suit	No. of Exp. Tol.(Group 1)	No. of Additional Exp. Tol.(Group 3)	Total No.of Exp. Only Tol.	No. of Days Wear Only Tol.(Gr. 2)
A	1	1	2	4
B	3	-	3	3
C	3	1	4	5
D	7	-	7	5 (+2)*
E	1	1	2	3
F	2	2	4	4
Av.	2.8	1.3	3.7	4.0

* Man in Group 2 "broke" before man in Group 1. A new man wore suit only and tolerated 2 more days before he also "broke".

12. It is obvious that, for the worn suits used in this test, both leakage and desorption took place. The burns resulting from leakage occurred sooner than those from desorption since the men in Group 1 tolerated 2.0 exposures, whereas those in Group 2 tolerated 4.0 days of wear. This was not entirely consistent, however, since for suit D 2 men in Group 2 "broke" at the time the man in Group 1 "broke". That the results of desorption only from the wear of contaminated carbon clothing can be severe was demonstrated by the scrotal burns sustained by the men in Group 2. These men did not wear protective shorts and, as can be seen from Table XV in the Appendix, all sustained crusted lesions of the scrotum 10 to 15 days after the test. The small number of additional exposures tolerated by the men in Group 3 was expected since it had been shown by chemical tests (unpublished data) that the leakage of H through worn carbon clothing increases with the number of exposures.

13. The problem of desorption of vesicants from vapor contaminated carbon cloth is one of the disadvantages of carbon cloth when compared with CC-2 cloth. Desorption from CC-2 impregnated cloth is of little significance since, in the case of H vapor, the agent is neutralized rapidly by chemical reaction.

(d) HN-1 Tests.

14. One of the advantages of carbon cloth over CC-2 impregnated cloth is the much greater protection it may afford against vesicants in general. Earlier reports of this series (NRL Reports Nos. P-2464 and P-2701) give data obtained with new carbon cloth demonstrating this advantage. Two tests with worn carbon-rayon cloth #110 were carried out using HN-1 at a CT of 2000 (60 min.) with continuous wear of the suits. The data are summarized in Table III. More complete data are presented in Tables XVII and XVIII in the Appendix.

Table III

HN-1 Tests

Conditions: HN-1 at CT 1200 (60 min.); 90°F, 65% R.H. 1-1/2 layer (carbon-rayon shorts, gloves and socks).

Cloth Modification	Wearing Period	No. of Men	No. of Breaks	Av.No.of Exp. Tolerated	Av.Total CT Tolerated
110	None	6	5	5.0+	10000+
110	1 land. + 9 days	4	4	2.0	4000
110	3 land. + 5 days	4	4	2.8	5600

15. The data in Tables I and III show that comparable worn carbon-rayon #110 suits gave protection against HN-1 at total CTs of the order of twice that against H. This approximate ratio is in keeping with the total CTs tolerated by new carbon-rayon #110 suits (See NRL Report No. P-2701) and therefore indicates that the loss in protection due to wear was comparable for the two agents.

(2) Suits from 1945 Wearing Trials.

16. In view of the good results obtained with the carbon-rayon #148 suits from the 1944 wearing trials the 1945 wearing trials were carried out for a total of 6 weeks of rather vigorous wear. After suitable screening tests it was evident that standard exposures at CT 1200 could not be employed for most of the suits from the 1945 trials. Hence, the tests were conducted as 1-1/2 layer tests at CTs of 300 and 600 (60 min.) with continuous wear of the clothing. For comparative purposes, the exposure values obtained for the corresponding new carbon suits (from NRL Report No. P-2701) are also included.

(a) Carbon Coated and Impregnated Cloths.

17. One carbon coated and two carbon impregnated type suits were tested in the chamber. The results obtained are summarized in Table IV. More complete data are presented in Tables XIX through XXII in the Appendix.

Table IV

Carbon Coated and Impregnated Suits

Conditions: H at CT 300-1200 (60 min.), 90°F, 65% R.H.

Suit Modification	Wearing Period	CT of Exp.	No. of Men	No. of Breaks	Av.No.of Exp.Tol.	Av. Total CT Tol.
S-38	None	1200	7	7	6.0	7200
S-38	4 Wks.	300	7	7	1.6	480
Methocel	None	1200	7	6	3.7+	4440+
"	2 Days	600	6	6	3.7	2220
Casein	None	1200	8	8	2.0	2400
"	2 Days	300	6	6	1.8	540

18. As can be seen from Table IV, the S-38 carbon coated suits had lost a very large part of their protective capacity after 4 weeks of wear, the protection given by the worn suits being less than a standard exposure of CT 1200. The Methocel carbon impregnated suits lost half their protective capacity after only 2 days of wear and the casein impregnated suits lost 3/4 of their protective capacity after only 2 days of wear. Although the protection given by the worn Methocel suits was greater than a standard exposure at CT 1200, the rapid loss of protection on wear showed that the wearing qualitites of these suits was poor. The very large loss in protection due to wear of the casein suits show that these suits had even poorer wearing qualities than the Methocel suits.

(b) Carbon-Rayon Cloths.

19. Seven types of carbon-rayon cloth, worn for various periods, were tested in the chamber. The carbon-rayon #176 suits were of three types; one was plain, another had rubberized fabric reinforcing patches on the knees and elbows and the third had carbon-rayon #176 reinforcing patches. However, since most of the "breaks" in chamber tests occur because of burns on the shoulders and back, no distinction has been made among these three types. The data obtained are summarized in Table V. More complete data are given in Tables XXIII through XXXII in the Appendix. No data are available for chamber tests of new spun rayon suits. Carbon-rayon #190 and 191 cloths are essentially the same except for a slight difference in the reinforcing thread. It is considered, therefore, that the exposure value for the new carbon-rayon #191 also applies to the carbon-rayon #190. This reasoning also applies to the pair consisting of carbon-rayon #192 and 193 cloths.

Table V

Carbon-Rayon Suits

Conditions: H at CT 300-2400 (60 min.); 90°F, 65% R.H.

Suit Modification	Wearing Period	CT of Exp.	No.of Men	No.of Breaks	Av.No.of Exp. Tolerated	Av.Total CT Tol.
148	None	1200	4	2	10.5+	12600+
148	4 weeks	300	8	8	2.0	600
176	None	2400	8	7	4.5+	10800+
176	2 weeks	600	6	5	2.0+	1200+
176	4 weeks	300	6	6	2.2	660
176	6 weeks	300	6	6	1.0	300
190	4 weeks	300	5	5	2.0	600
191	None	2400	7	7	4.4	10560
191	4 weeks	300	5	5	1.6	480
192	4 weeks	300	6	6	2.2	660
193	None	2400	8	7	4.9+	11760+
193	6 weeks	300	8	6	2.0+	600+
Spun	3 weeks*	300	2	1	2.0+	600+
"	6 weeks	600	4	4	2.0	1200

* The suits used in this test were withdrawn from the wearing trials because they showed signs of having received excessively severe wear. It is considered, therefore, that the result obtained in this particular test does not represent the true comparative wearing qualities of this type of cloth.

20. The data in Table V show that, in general, the worn suits had lost a very large part of their protective capacity as a result of the wear given them. Thus, only the carbon-rayon #176 suits worn for 2 weeks and the spun rayon suits worn for 6 weeks gave protection equal to a standard exposure at CT 1200. In view of the low CTs tolerated by the other groups of suits, it is indicated that approximately 2 weeks of fairly hard wear may be considered as the useful wearing life for most of these carbon-rayon types. The spun rayon type which appeared to give the best protection has the disadvantage of being a very heavy material and was found to be more uncomfortable to wear in hot weather than the other types.

21. Several tentative conclusions may be drawn from a comparison of the results obtained in this series of tests. The carbon-rayon #148 and 176 with 4 weeks wear gave essentially the same degree of protection. This indicates that the extra Nylon reinforcement in the carbon-rayon #176 did not give the extra wearing life that it was expected to give. The greater protection given by the carbon-rayon #193 over #176 at 6 weeks wear indicates that a decrease in the carbon content of the fiber, from 32% to 28%, gives added wearing life. This is attributed to the fact that a rayon fiber containing carbon is more brittle with a higher percentage of carbon and is more readily broken on abrasion and flexing. The protection given by the carbon-rayon #176 suits with 6 weeks wear was only slightly better than that given by untreated dungaree suits (see NRL Report No. P-2579). The results obtained in the carbon-rayon #176 series with varying periods of wear showed that the greatest loss in protection occurred during the first two weeks of wear and tapered off after that. The results of the tests with carbon-rayon #190 and 191 indicate that, on wear, PCI carbon behaves similarly to the N-182 carbon used in the other types. The results of the tests of the carbon-rayon #190 and 191 and carbon-rayon #192 and 193 indicate no significant difference in wearing qualities due to the slight differences in reinforcement of the carbon-rayon threads.

22. In general the protection given by the carbon-rayon suits from the 1945 wearing trials was unexpectedly low, particularly in view of the results obtained with the worn carbon-rayon #148 suits in the 1944 wearing trials. Consideration must be given, however, to the fact that the preparation of the carbon-rayon yarn from which the suits are made is still in the experimental stage and that reproducibility of the quality of yarns from different spinning operations is difficult to obtain. The results obtained in the wearing and chamber trials, therefore, cannot be considered as absolute.

(c) Analytical Data:

23. Very few of the worn suits used in these tests were analyzed for vesicant vapor pick-up, mostly because the number of exposures tolerated was too low. In a few cases it was observed that foreign matter on the worn suits led to erratic analytical results and hence were not considered reliable. One example of the "pick-up" rate of worn carbon clothing is presented to compare it with new carbon clothing. Samples from the carbon-rayon #148 suits from the 1944 wearing trials were analyzed for H "pick-up" by the NaOCl method. The methods of sampling and analysis used were described in NRL Report P-2701. The results are summarized in Table VI.

Table VI

Average Total H "Pick-up" for Carbon-Rayon #148 Suits.

Suits	γ H/cm.^{2} After Exposure No. 1	2	3	4	5	6	7	8	9	10	11	12
New*	21	26	34	73	73	76	83	99	109	112	114	155
Worn**	-	25	33	-	52	-	75	-	101	-	-	-

* Data from NRL Report No. P-2701.
** Worn 5 days of jungle warfare in 1944 trials.

24. The data in Table VI show that the worn suits picked-up slightly less H per exposure than the new suits. Assuming a linear relationship between "pick-up" and number of exposures, a plot of the data indicates a "pick-up" of 13 γ H/cm.^{2}/exp. for the new suits and 11 γ H/cm.^{2}/exp. for the worn suits.

25. Chemical tests (unpublished data) have shown that new carbon-rayon cloth shows no leakage of H vapor when exposed to concentrations such as are used in the chamber (i.e. 20 γ H/l.). Some of the worn carbon-rayon suits, however, do show leakage. Table VII gives a few examples of data obtained in leakage test. The cloths used for the leakage tests did not all come from suits worn under the same conditions as those used in the chamber, but examples were chosen which approximated the same conditions.

Table VII

Leakage of H Vapor Through Various Cloths.

Conditions: 1 hour exposure at approximately 20 γ H /l.

Cloth Type	Modification	Wearing Period	% Leakage
Carbon-Rayon	110	9 Days	5.0
" "	110	3 land.	2.8
" "	148	5 Days	0
" "	176	3 Weeks	4.1
Carbon-Impregnated	Methocel	2 Days	0
CC-2 Impregnated	Aqueous	None	1.7

26. The data in Table VII offer a partial explanation for the very low order of protection given by some of the worn suits in the chamber. Thus, the carbon-rayon #110 and 176 cloths showed a considerable degree of leakage and also did not give good protection. The carbon-rayon #146 and the Methocel cloths showed no leakage and gave better protection when compared to that given by the corresponding new cloths.

SUMMARY AND CONCLUSIONS

1. Chamber tests with H and HN-1 have been conducted to evaluate the protection afforded by various types of worn carbon clothing in an effort to determine the effect of wear on protection. The clothing used in these tests was from two wearing trials conducted at Camp Lejeune, N. C., during the summers of 1944 and 1945.

2. From the tests of the clothing from the 1944 wearing trials the following conclusions were drawn:

(a) Carbon-rayon #110 suits lost a large part of their protective capacity as a result of 1-3 amphibious landings followed by 5 - 9 days wear. However, under the same or less severe conditions of wear, CC-2 impregnated suits gave less protection to H vapor than the corresponding carbon-rayon #110 suits.

(b) Carbon-rayon #148 suits lost only a small part of their protective capacity after 5 days of wear under simulated jungle warfare conditions.

(c) The worn carbon-rayon #110 suits showed considerable leakage to H Vapor when measured both chemically and in the chamber tests.

(d) The desorption of H from contaminated worn carbon-rayon #110 and 148 suits was sufficient to cause moderate to severe burns on wearing.

(e) The percentage loss in protective capacity of carbon-rayon #110 suits on wear was approximately the same towards H and HN-1.

3. The wearing periods for the carbon suits in the 1945 wearing trials were too long in many cases. As a consequence the protection given by many of the suits was of such a low order that some of the following conclusions must be considered as only tentative:

(a) Of the suits tested, only the Methocel carbon impregnated, with 2 days wear, the carbon-rayon #176 with 2 weeks wear, and the spun rayon with 6 weeks wear gave protection comparable to one standard exposure at CT 1200.

(b) It was indicated that approximately 2 weeks of fairly severe wear under semi-tropical conditions was about the limit for the useful wearing life of carbon-rayon suits of the #176 type.

(c) It was indicated that the spun rayon type had better wearing life than the other carbon-rayon types.

(d) It was indicated that the use of different types of Nylon reinforcing of the carbon-rayon fiber did not affect the wearing qualities materially.

(e) It was indicated that carbon-rayon cloths containing PCI and N-182 carbon were equivalent in their behavior towards wear.

(f) It was indicated that a carbon content of 28% in the fiber had better wearing qualities than one containing 32% carbon.

(g) Carbon-rayon #176 cloth, worn for 6 weeks, gave essentially no protection over that given by plain untreated dungaree cloth.

4. Analytical data obtained for several of the worn suits showed that the agent vapor pick-up was lower for the worn suits than for the new suits and that after wear, carbon-rayon cloths may show considerable leakage to H Vapor.

RECOMMENDATIONS

1. It is recommended that carbon-rayon suits of the present #176 type be considered as having a useful life of approximately 2 weeks under severe wearing conditions.

2. It is recommended that, subject to confirmation, carbon-rayon cloths containing approximately 28% carbon be considered superior to those containing a higher percentage of carbon.

3. It is recommended that the spun rayon type of cloth be investigated further to confirm its apparent superiority in wearing qualities over the other types.

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The subjects participating in these tests were volunteer personnel from NTC, Bainbridge, Maryland.

Appendix

Table VIII

Legend - Physiological Readings

Symbol	Reaction
E^{O}	Moderate Erythema
E	Intense Erythema
E+	Papular Erythema
NPV	Numerous Pin-point Vesicles
V	Vesicle
NV	Numerous Vesicles.

APPENDIX

Table IX

Legend - Body Areas

Abbr.	Area	Abbr.	Area
aaf	anterior axillary folds	par	posterior arms
aar	anterior arms	pen	penis
abd	abdomen	ple	posterior legs
af	axillary folds	pne	posterior neck
ale	anterior legs	pop	popliteal fossae
ane	anterior neck	psh	posterior shoulders
ar	arms	pthi	posterior thighs
ash	anterior shoulders	sc	scapulae
athi	anterior thighs	scr	scrotum
ax	axillae	sh	shoulders
bt	buttocks	st	upper sternum
C_7	7th cervicular region	th	thorax
cf	cubital fossae	thi	thighs
cl	clavicles	umar	upper medial arms
dh	dorsum of hands	vth	ventral thorax
dth	dorsal thorax	wr	wrists
el	elbows		
fa	forearms		
igf	intergluteal folds		
il	iliac crest		
ing	inguinal region		
kn	knees		
le	legs		
lne	lateral neck		
lth	lateral thorax		
lum	lumbar region		
ne	neck		
oint	area covered by ointment		
paf	posterior axillary folds		

Table X

Carbon-Rayon #110 - 1 Landing + 9 Days Wear (1944)

Conditions: H at CT 1200 (60 min.); 90°F, 65% R.H.
1-1/2 Layers (CC-2 impreg. shorts) - Ointment used on neck

Date Started: 9/18/44

No. of Exposures Tolerated	Readings (Hours after Last Exposure) 24	48
2	E sc, sh E° dth	E sc E° dth
1	E sc E° scr	E sh, sc
2	E sh, sc E° dth	E sc, dth E° sh
2	E sc	E ash,sc,dth E° scr,thi,kn

Av. 1.8

Table XI

Carbon-Rayon #110 - 3 Landings + 5 Days Wear (1944)

Conditions: H at CT 1200 (60 min.); 90°F, 65% R.H.
1-1/2 Layer (CC-2 impreg. shorts)- Ointment used on neck

Date Started: 9/18/44

No. of Exposures Tolerated	Readings (Hours after Last Exposure)	
	24	48
1	E sh,sc E° dth	E sh,sc
2	E sc,paf,scr E° thi,kn	E sc E° sh,scr
1	E sc E° dth	E sc,dth E° sh
1	E sc E° sh,thi,kn,le	E sh,sc,thi,kn,le E° ar,fa,cf,pop

Av. 1.3

Table XII

Carbon Rayon #148 - 5 days of Jungle Warfare (1944)

Conditions: H at CT 1200 (60 min.); 90°F, 65% R.H.
1-1/2 Layer (CC-2 impreg. shorts)-Ointment used on neck

Date Started: 10/31/44

No. of Exposures Tolerated	Readings (Hours after Last Exposure) 24	48
12	E ax E° sh,sc,dh	E ax E° psh,sc
7	E lum E° ne,st	E ne,st,lum
7	E thi,pop E° psh	E thi,psh,sc,pop E° ne
9	E sc,psh E° ne,cl	E pne,sc E° ane,lne,psh
6	E psh,sc	E psh,sc,pne
7*	E kn,athi (Spilled oil E° sc,lum (on thigh) (not included in av.)	E kn,thi,lum
5*	E oint. (not included in av.)	E+ oint. E° sc
5*	E oint. (not included in av.)	E+ oint.

Av. 8.2

Note: Two of the men above were withdrawn due to neck burns and one because he spilled fuel oil on his suit. It was demonstrated later that the use of ointment with carbon clothing or contamination of carbon clothing with oil decreases the protection due to increased desorption of H. Therefore, these men are not included in the average. After the 5th exposure, CC-2 impregnated collars were sewn into the suits to prevent further burns from desorption. In all subsequent exposures no ointment was used and a CC-2 impregnated hood was worn during exposure in addition to the regular hood.

Table XIII

Test for Desorption from Carbon Rayon #148 worn 5 days of Jungle Warfare
(See Table XII)

Conditions: Wear only, no exposures, 3 days continuous wear.
1-1/2 Layer (CC-2 impreg. shorts)

Tests started on day each suit was "broken" in chamber exposures.

No. of Previous Exposures in Chamber	Readings (Hours after 3 Days Wear) 0	24	48
12	E° st,psh,sc	E° face,st	E sh,cf,sc,paf E° vth,ax,pthi,pop, le
7	E° face	E° face,ne,st	E° face,ne,st
7	E psh,sc,igf	E psh,sc	E psh,sc,dth E° ne,st
9	No Readings E°	or Greater	
6	No Readings E°	or Greater	E° face
7	E° athi,kn	E kn,athi,pop	E athi,kn,pop E° face,ash,ax

Table XIV

Carbon Rayon #110 - 9 days wear (1944) - Exposure Only (Group 1)

Conditions: H at CT 1200 (60 min.); 90°F, 65% R.H.
1-1/2 Layers (CC-2 impreg. Shorts) - Ointment used on neck
The men wore the suits for exposures only.

Date Started: 10/17/44

Suit**	No. of Exposures Tolerated	Readings (Hours after Last Exposure) 24	48
A	1	E thi,kn	E+ athi,kn E° pthi
B	3	E ax,lth,cf,athi kn,sc,dth,paf E° st,ash,pthi pop	E ash,ax,af,cf,thi,kn,sc, dth,pop E° cl
C	3	E psh,paf,sc E° ash,ax,athi, kn,dth	E ash,ax,lth,sc,dth,paf E° athi,kn,el
D	7	E sc	E sc E° st,ash
E	1	E ash,sc,dth, paf E° athi,kn	E ash,sc,dth,paf E° st,lth,athi,kn
F	2	E sc E° athi,kn	E sc E° ash,athi,kn

Av. 2.8

** See also Tables XV and XVI

Table XV

Carbon Rayon #110 - 9 days Wear (1944) - Wear only (Group 2)

Conditions: H at CT 1200 (60 min.); 90°F. 65% R.H.
1 Layer (plain shorts). No ointment
The men were not exposed in the chamber but wore the suits continuously between exposures.

Date Started: 10/17/44

Suit**	No. of Exp. for Suit	No. of Days Additional Wear	Total Wear (Days)	Readings (Hours after Last Day of Wear) 0	24
A	2	2	4	E+ scr E ax,aaf,ing,cf, pen,thi E° abd,pop	Crusting scr,pen E vth,ash,aaf,lth abd,ing,pop E° sc,dth,paf
B	3	0	3	E ne,vth,sh,ar, cf,thi,kn,scr pen,sc,dth, pop,paf E° dh	E+ scr(12 days- crusted scr,pen) E ne,sh,af,fa,th, cf,thi,ing,kn, pen,sc,ax,bt, pop
C	4	1	5	E ash,st,cl,ing, sc,dth E° ax,kn,psh,bt	E ash,vth,aaf,ax, ing,thi,sc,dth E° scr,kn,bt (10 days - crusted scr)
D	(5)	0	5	E ne E° sh,st	E sh,sc,ne (15 days-crusted scr) E° scr,pen,bt
D***	5+2	0	(2)	E sc,dth E° ash,vth	E ash,vth,sc,dth (13 days - scaling scr)
E	2	1	3	E sc,psh E° st,ax,cf,dth, paf,el	E+ scr (12 days- crusted scr) E ne,st,sh,ax,th, sc,paf E° ing,kn,bt, pop,el
F	4	0	4	E+ scr,pen E ash,vth,ne,ax ing,sc,dth,paf E° cf,kn,bt	E+ sc,dth (13 days- crusted scr) E scr,pen,ash,vth, ax,ing,athi,kn, paf,bt,pop
	Av.3.7	Av.0.6	Av.4.0		

** See also Tables XIV and XVI

*** Since suit had not "broken" in chamber but the man in the "wear only" part of the test "broke", a new man was put in the suit for the additional wear.

Table XVI

Carbon Rayon #110 - 9 Days Wear (1944) - Exposure Only (Group 3)

Conditions: H at CT 1200 (60 min.); 90°F, 65% R.H.
1-1/2 Layer (CC-2 impreg. shorts), Ointment used on neck

Men wore suits for exposures only after corresponding men from Group 1 were "broken".

Date Started: 10/17/44

Suit**	No. of Previous Exposures	No. of Additional Exp. Tolerated	Readings (Hours after Last Exp.) 24	48
A	1	1	E+ athi,kn E pop E° ash,aaf,ax,abd, sc,dth	E athi,kn,ash, aaf,ax E° sc,dth,pop
B	3	-	-	-
C	3	1	E sh,sc,paf E° st,athi,kn, dth,el	E ash,sc,dth E° st,kn,pop
D	7	-	-	-
E	1	1	E st,ash,cf,ax, lth,ne,sc,dth, paf E° athi,kn,el, pop	E ash,ax,lth, pne,sc,dth, paf E° ane,st
F	2	2	E lth,psh E° ash,sc	E ash,athi,kn, sc,dth E° pthi
	Av. 2.8	Av. 1.3		

** See also Tables XIV and XV

Table XVII

Carbon Rayon #110 - 1 landing + 9 days wear (1944)

Conditions: HN-1 at CT 2000 (60 min.); 90°F, 65% R.H.
1-1/2 Layers (Carbon Rayon #143 shorts, improvised carbon coated gloves and socks)

Date Started: 9/11/44

No. of Exposures Tolerated	Readings (Hours after Last Exposure) 24	48
2	E ne E° sh,sc,dth	E+ ne E sc,dth E° sh,igf
2	E sh,sc,dth	E sh,sc,dth E° ne,aaf
2	E sc E° ne	E+ ne E scr,sc E° sh
2	E+ ne E° sh	E+ ne E° sh,sc

Av. 2.0

Table XVIII

Carbon Rayon #110 - 3 landings + 5 days wear (1944)

Conditions: HN-1 at CT 2000 (60 min.); 90°F, 65% R.H.
1-1/2 Layer (Carbon Rayon #143 shorts, improvised carbon coated gloves and socks).

Date Started: 9/11/44

No. of Exposures Tolerated	Readings (Hours after Last Exposure)	
	24	48
3	E+ ne E sh,sc E° dth	E° ne,sh
3	E+ ne	E+ ne E° sc
2	NV lne E ane,pne	V lne E+ ane,pne E° st,sh,sc
3	E ne	E° ne

Av. 2.8

Table XIX

Carbon Coated (S-38) - 4 Weeks Wear (1945)

Conditions: H at CT 300 (60 min.); 90°F, 65% R.H .
1-1/2 Layer (CC-2 impreg. shorts)

Date Started	No. of Exp. Tolerated	Readings (Hours after Last Exposure) 24	48
8/13/45	1	E cf,psh,sc E° ne,st,ash,ar,vth, thi,kn,le,pop,el, C_7, dth	No readings available
	2	E ne,st,cf,kn,psh,sc, dth E° ash,ar,ax,athi, ale,el	E ne,st,sh,ar,cf,lth,paf, sc,pthi,pop,dth E° vth,el,le,athi,kn(72 hrs.)
8/21/45	2	E psh,sc,dth E° ne,st,cf,athi,kn, ale,C_7	E sh,cf,kn,ale,sc,dth E° ne,st,umar,athi,af,lth, el,C_7
	1	E psh,sc E° ne,st,ash,kn,el, C_7,dth	E psh,el,sc E° ne,st,ash,kn,C_7,dth
	1	E psh,sc E° ash,athi,kn	E psh.sc E° ash,cf,pne,dth
	2	E sh,aar,cf,kn,pne, sc E° ane,st,lne,umar, thi,pop,ple,paf, el,C_7,dth	E+ cf E sh,aar,sc,dth E° ne,st,umar,ax,lth,athi, kn,ale,paf,C_7,pop
	2	E sh,cf,sc,dth E° st,umar,pne,paf, C_7,pthi,pop	E+ cf E st,sh,aar,sc,dth E° ne,umar,paf,el,C_7, pthi,pop,ple

Av. 1.6

Table XX

Carbon Impregnated (Methocel) - 2 days wear (1945)

Conditions: H at CT 300 (60 min.); 90°F, 65% R.H.
1-1/2 Layers (CC-2 impreg. shorts)

Date Started: 8/13/45

No. of Exposures Tolerated	Readings (Hours after Last Exposure)	
	24	72
2*	E^{o} st,pne	E^{o} st
2*	No Readings E^{o} or Greater	E psh,sc E^{o} C_7,dth

Av. 2.0++

Note: This test was carried out on a screen. The results obtained are not included in the evaluation of this type of cloth.

Table XXI

Carbon Impregnated (Methocel) - 2 days wear (1945)

Conditions: H at CT 600 (60 min.); 90°F, 65% R.H.
1-1/2 Layers (CC-2 impreg. shorts)

Date Started: 9/12/45

No. of Exposures Tolerated	Readings (Hours after Last Exposure) 24	48
4	E athi,kn,pop E° ne,st,cf,psh,el	E pop E° ne,st,thi,kn,paf,psh,sc, dth,ple
4	E psh,sc E° ane,ash,athi,kn, pne,dth	E sh,sc E° ne,st,cf,athi,kn,ale,C_7, dth
4	E psh,paf,sc E° ne,st,ash,ar,cf, athi,kn,dth	E° ne,st,ar,kn,paf,psh,sc,dth
4	E ane,st,psh,sc,dth E° ash,cf,athi,kn, par,el,lne	E psh,dth E° ne,st,sc
3	E sh,athi,kn,paf, sc,dth E° ne,st,ar,cf,el, pthi,pop,ple	E sh,aar,cf,athi,kn,pne,paf, sc,dth E° ane,lne,st,lth,le,C_7, pthi,pop (72 hours)
3	E pne,psh,sc,dth E° ane,lne,st,ash, cf,athi,kn	E ne,st,sh,umar,cf,th,athi, kn,paf,sc E° ale,pop

Av. 3.7

Table XXII

Carbon Impregnated (Casein) - 2 days wear (1945)

Conditions: H at CT 300 (60 min.); 90°F, 65% R.H .
1-1/2 Layers (CC-2 impreg. shorts)

Date Started	No. of Exp. Tolerated	Readings (Hours after Last Exposure) 24	48
8/13/45	2	E athi,kn,ale,psh,sc, dth E° ne,st,ash,ar,af,lth, vth,el,C_7,pthi,pop, ple	E ne,st,sh,aar,cf,af,th, thi,kn,le,pop,C_7,sc (72 hours)
	2	E cf,kn,le,pop,psh,sc, dth E° ne,st,ash,aar,af,lth, vth,abd,thi,C_7	E ne,st,sh,cf,af,th,thi, kn,le,pop,sc E° par,el (72 hours)
9/12/45	2	E thi,kn,le,pop,psh, sc,dth E° ash,cf,pne	E sh,ar,cf,th,abd,thi, kn,le,pop,pne,paf,sc E° ane,lne,st
	1	E sh,thi,kn,pop,ple, sc E° ne,st,aar,umar,cf, ale,paf,dth	E sh,cf,thi,kn,pop,ple, sc,dth E° ne,st,aar,ale
	3	E sh,cf,paf,sc,dth, pthi,pop,ple E° ne,st,umar,athi, kn,ale,par,el	E ne,st,sh,cf,umar,thi, kn,le,pop,paf,sc,dth E° aar (72 hours)
	1	E sh,cf E° ne,st,el,sc,dth	E cf,pne,psh E° ane,lne,st,ash,vth, el,sc,dth

Av. 1.8

Table XXIII

Carbon Rayon #148 - 4 weeks wear (1945)

Conditions: H at CT 300 (60 min.); 90°F, 65% R.H.
1-1/2 Layer (CC-2 impreg. shorts)

Date Started	No. of Exp. Tolerated	Readings (Hours after Last Exposure) 24	48
8/21/45	1	E athi,kn E° st,ale,psh,cl, sc,dth	E athi,kn,ale,psh,sc,dth E° nc,st,cf,C_7
	3	E sh,sc,dth E° ne,st,C_7,pthi, pop,ple	E sh,aar,kn,sc,dth,pop E° ne,st,thi,le (96 hours)
8/28/45	2	E psh,sc E° ash,cf,thi,kn,le pop,C_7,dth	E sh,cf,kn,C_7,sc,dth E° ne,aar,umar,ax,ale,athi, pop
	3	E thi,kn,le,pop, psh,sc E° ne,ash,cf,C_7,dth	E sh,aar,thi,kn,le,pop,sc,dth E° cf,pne,C_7 (120 hours)
	3	E sh,aar,cf,kn,sc E° ne,umar,ax,athi ale,C_7,dth	E sh,ar,cf,sc E° kn,pne,C_7,dth,pthi,pop
	1	E sc E° ne,st,cf,psh,C_7 dth	E cf,sc E° ne,aar,umar,ax,athi,kn, ale,psh,C_7,dth
	1	E sh,sc E° ne,st,C_7,dth	E sh,sc E° ne,st,cf,athi,kn,C_7,dth
	2	E psh,sc,pop E° ne,st,ash,aar, cf,ax,th,thi, kn,le,C_7	E sh,cf,kn,sc,dth,pthi, pop,ple E° ne,st,aar,athi,kn,C_7

Av. 2.0

Table XXIV

Carbon Rayon #176 - 2 weeks wear (1945)

Conditions: H at CT 600 (60 min.); 90°F. 65% R.H.
1-1/2 Layer (CC-2 impreg. shorts)

Date Started: 8/28/45

No. of Exposures Tolerated	Readings (Hours after Last Exposure) 24	48
3	E sh E° kn,pne,el,sc,dth, pthi,pop,ple	E ash (120 hours) E° kn,psh,sc
1	E ne,st,sh,aar,cf,C_7 sc,dth E° umar,vth,abd,thi, kn,le,pop,paf	E ne,st,sh,aar,cf,C_7,sc,dth E° umar,ax,lth,thi,le,kn,pop
2	E psh,sc E° ne,st,athi,kn, ale,C_7,dth	E psh,sc E° ne,st,cf,athi,kn,ale,C_7, dth
1	E athi,kn,sc E° ne,st,psh	E athi,kn,sc E° ne,sh,aar,umar,cf,ax,ale, dth
3*	E° ne,st,umar,aar, psh,C_7,sc,dth	E° ne,st,sc (120 hours)
2	E kn,psh,sc E° ne,st,ash,aar, umar,cf,ax,thi, pop,le,C_7,dth	E psh,sc E° ne,st,ash,aar,umar,cf,ax, athi,kn,ale,C_7,dth

Av. 2.04

Table XXV

Carbon Rayon #176 - 4 weeks wear (1945)

Conditions: H at CT 300 (60 min.); 90°F, 65% R.H.
1-1/2 Layer (CC-2 impreg. shorts)

Date Started: 8/21/45

Suit Type	No. of Exp. Tolerated	Readings (Hours after Last Exposure) 24	48
Plain	3	E psh,sc,dth E° ne,st,ash,athi, kn,ale,C_7	E sh,sc,dth,kn E° umar,cf,athi,ale,C_7 (96 hrs.)
	1	E pne,psh,sc E° ane,st,lne,ash, umar,cf,C_7,dth	E ne,st,sh,cf,sc E° el,C_7,dth
Cloth	2	E psh,sc,dth,C_7 E° ne,st	E psh,sc E° pne,C_7,dth
Patch	2	E sh,cf,kn,el,sc E° ne,st,umar,athi ale,paf,C_7,dth	E sh,aar,cf,kn,sc,st E° ne,umar,af,athi,ale,C_7,dth
Rubber	2	E kn,psh,sc E° ne,st,ash,umar cf,abd,thi,le, pop,paf,C_7,dth	E psh,sc E° ash,umar,cf,abd,thi,kn,pop, ple,paf,C_7,dth
Patch	3	E psh,sc E° ne,st,el,C_7,dth pthi,pop,ple	E psh,sc,dth E° ne,st,ash,aar,cf,kn,C_7 (96 hours)

Av. 2.2

Table XXVI

Carbon Rayon #176 - 6 weeks wear (1945)

Conditions: H at CT 300 (60 min.); 90°F. 65% R.H.)
1-1/2 Layer (CC-2 impreg. shorts)

Date Started: 8/13/45

Suit Type	No. of Exp. Tolerated	Readings (Hours after Last Exposure) 24	48
Cloth Patch	1	E psh,el,sc,dth E° ne,st,ash,cf,dh, wr,vth,athi,kn, ale	E ne,st,sh,cf,athi,kn,ale psh,sc,dth,pop E° lth,vth,abd,el
	1	E psh,sc E° dth	E psh,sc,dth E° pne,st
Plain	1	E sh,pne E° kn,par,el,sc,dth	E sh,athi,kn,sc E° ne,st,ar,cf,ale,el,C_7,dth
	1	E ane,psh,sc E° st,lne,cf,pne, paf	E ne,st,cf,psh,sc E° ash,aar,el,C_7,dth
Rubber Patch	1	E sh,paf,par,sc E° ne,st,aar,cf,fa, vth,el,C_7,dth	E ne,st,psh,sc,dth E° ash,cf,vth,kn,el
	1	E sh,pne,C_7,sc,dth E° ane,lne,st,ar,cf, fa,el,pthi,pop, ple	E ne,st,sh,aar,cf,kn,paf,C_7, sc,dth,pthi,pop,ple E° lth,athi,ale

Av. 1.0

Table XXVII

Carbon Rayon #190 - 4 weeks wear (1945)

Conditions: H at CT 300 (60 min.); 90°F, 65% R.H.
1-1/2 Layers (CC-2 impreg. shorts)

Date Started	No. of Exp. Tolerated	Readings (Hours after Last Exposure) 24	48
8/28/45	2	E sc E° umar,cf,ax,athi, kn,psh,C_7,dth	E cf,kn,psh,C_7,sc,dth E° ne,st,ash,aar,umar,ax, vth,athi,ale
9/12/45	3	E sh,ef,athi,kn,ale paf,sc,dth E° ar,lth,vth,el, pthi,pop,ple	E ne,st,sh,aar,cf,af,thi, kn,le,pop,C_7,sc,dth (72 hours)
	1	E sh,paf,sc,dth E° ne,st,aar,cf	E psh,sc,dth E° ash,cf,par,pthi,pop,ple
	3	E athi,kn,sc E° ne,st,cf,sh,dth, pthi,pop	E sh,umar,cf,thi,kn,le,pop, paf,C_7,sc,dth E° ne,st,aar (72 hours)
	1	E sh,sc E° ne,st,cf,dth	E sh,sc,dth E° ne,st,cf,athi,kn,ale, par,el

Av. 2.0

Table XXVIII

Carbon Rayon #191 - 4 weeks wear (1945)

Conditions: H at CT 300 (60 min.); 90°F, 65 % R.H.
1-1/2 Layers (CC-2 impreg. shorts)

Date Started	No. of Exp. Tolerated	Readings (Hours after Last Exposure) 24	48
8/28 8/45	2	E cf,kn,psh,C_7,sc E° ne,st,ash,aar, umar,vth,thi,le pop,paf,dth	E sh,aar,umar,cf,athi,kn, pne,C_7,sc,dth E° ane,lne,st,ax,le,pthi, pop
9/12 2/45	1	E dth E° sh,cf,paf,sc	E psh,sc,dth E° cf
	1	E paf,psh,sc,dth E° ne,st,ash	E sh,sc,dth E° ne,st
	3	E sh,ar,cf,paf, sc,dth E° ne,st,umar,lth, vth,abd,thi,kn, le,pop,el	E sh,ar,cf,th,abd,thi,kn le,pop,paf,sc,lum (72 hours)
	1	E psh,sc E° ne,st,ash,el, dth	E psh E° ne,st,el,sc,dth

Av. 1.6

Table XXIX

Carbon Rayon #192 - 4 weeks wear (1945)

Conditions: H at CT 300 (60 min.); 90°F, 65% R.H.
1-1/2 Layers (CC-2 impreg. shorts)

Date Started: 8/28/45

No. of Exposures Tolerated	Readings (Hours after Last Exposure) 24	48
2	E psh,sc E° ne,st,ash,aar,cf, athi,kn,ale,el, C_7,dth	E ne,st,sh,C_7,sc E° aar,umar,cf,athi,kn, ale,dth
1	E kn,psh,sc E° ne,st,ash,aar,cf, athi,ale,C_7,dth. pop	E cf,thi,kn,ple,pop,C_7, sc,dth,psh E° ne,st,ash,umar,aar,ax, lth,ale
3	E psh,sc E° ne,st,ash,athi,kn	E (with crusting) psh,sc E ash (120 hours) E° st
3	E sc E° ne,st,athi,kn, psh,C_7,dth	E psh,sc E° kn,C_7,dth (120 hours)
2	E sc E° ne,st,thi,kn,pop, ple,psh,C_7,dth	E sc E° ne,st,cf,athi,kn,psh, C_7,dth
2	E psh,sc,dth E° ne,st,ash,ar,cf, athi,kn,C_7	E ne,st,aar,cf,athi,kn,psh, C_7,sc,dth E° ash,le,pthi,pop

Av. 2.2

Table XXX

Carbon Rayon #193 - 6 weeks wear (1945)

Conditions: H at CT 300 (60 min.); 90°F, 65% R.H.
1-1/2 Layer (CC-2 impreg. shorts)

Date Started	No. of Exp. Tolerated	Readings (Hours after Last Exposure) 24	48
8/13/45	1	E psh,sc E° ne,st,dh,wr,par, el,C_7,dth	E ne,st,sh,cf,sc,dth E° fa,dh,wr,athi,kn,par,el
	2*	E° st,kn,psh,sc,dth	E psh,sc,dth E° st (72 hours)
8/21/45	2	E ne,st,sh,cf,sc E° umar,athi,kn. paf,C_7,dth	E st,sh,cf,sc E° ne,umar,ar,athi,kn,paf, el,C_7,dth
	1	E psh,sc E° ne,st,ash,kn, par,el,C_7,dth, pthi,pop	E ne,sh,sc E° st,cf,thi,kn,le,pop,C_7, dth
	3	E kn,psh,sc E° ne,st,ash,cf, athi,ale,C_7,dth	E sh,cf,athi,kn,ale,sc,pop (96 hours) E° ne,umar,paf,C_7,dth, pthi,ple
	2	E kn,psh,sc E° ne,st,ash,cf, athi,el,C_7,dth	E sh,cf,kn,C_7,sc,dth,pop E° ne,st,umar,aar,thi,le,paf
	2	E psh,C_7,sc,dth E° ne,st,ash,cf,kn	E+ sc E sh,dth E° cf,athi,kn,C_7
	3*	E° sh,cf,athi,kn, le,pne,el,sc,dth	E kn (96 hours) E° sh,cf,thi,le,pop,sc,dth

Av. 2.0+

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Table XXXI

Spun Rayon - 3 Weeks Wear (1945)

Conditions: H at CT 300 (60 min.); 90°F, 65% R.H.
1-1/2 Layer (CC-2 impreg. shorts)

Date Started: 8/13/45

No. of Exposures Tolerated	Readings (Hours after Last Exposure)	
	24	72
2*	No Readings E^{O} or Greater	E psh,sc,dth E^{O} pthi,pop,ple
2	E pne,psh,sc,dth E^{O} ane,lne,st,cf, thi,le,kn,pop, par,el	E ne,st,cf,athi,kn,psh,sc,dth E^{O} ash,ar,le,el,pthi,pop

Av. 2.0+

Table XXXII

Spun Rayon - 6 Weeks Wear (1945)

Conditions: H at CT 600 (60 min.); 90°F, 65% R.H.
1-1/2 Layer (CC-2 impreg. shorts)

Date Started: 8/28/45

No. of Exposures Tolerated	Readings (Hours after Last Exposure)	
	24	48
2	E cf,athi,kn,psh,sc E° ne,st,ax,lth,ale, el,C_7,dth	E cf,athi,kn,psh,C_7,sc,dth E° ne,st,ale
2	E cf,kn,psh,C_7,sc E° ne,st,ash,ar,ax, thi,le,pop,dth	E cf,kn,psh,C_7,sc,dth,pop E° ne,st,ash,ar,ax,thi,le
3	E kn,psh,sc,dth E° ne,st,aar,umar,cf, ax,lth,vth,athi, ale,C_7,pop	E ane,st,athi,kn,ale,psh,sc, dth E° ash,pop (120 hours)
1	E sh,pne,C_7,sc,dth E° ane,st,lne,umar, cf,ax,vth,kn	E ne,st,sh,cf,kn,C_7,sc,dth E° umar,ax,vth,athi,ale

Av. 2.0

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